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Poverty and Maternal Health Care Utilisation in Maharashtra: Associated Influences on Infant Mortality and Morbidity

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Poverty and Maternal Health Care Utilisation in Maharashtra: Associated Influences on Infant Mortality and Morbidity

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ABSTRACT

This paper explores the effects of poverty on access to maternal health care services (MHC), linking the use of MHC to two outcomes for the infant; mortality and nutritional status. Previous literature has documented an urban-rural dichotomy in infant survival and utilisation of MHC in India but little is known about the variations within urban areas. Rates of infant mortality are much higher in poorer sectors of the urban areas, suggesting that some differential utilisation of MHC exists between socio-economic groups.

In this paper the National Family Health Survey (1992/93) for Maharashtra is used to model use of antenatal and delivery care and associated influences on infant mortality and morbidity. A composite index is created to examine the influence of standard of living on use of MHC. Findings show that those living in poorer households in rural and urban areas have a lower utilisation of MHC services than those in the higher socio-economic strata. The low level of use of these services is associated with increased neonatal mortality. In addition, infants living in lower socio-economic groups in rural and urban areas have an increased risk of poor nutritional status and neonatal mortality.

INTRODUCTION

The importance of maternal health services in reducing maternal and infant morbidity and mortality has received increasing recognition since the Cairo Conference on Population and Development. Previous studies have shown that the uptake of maternal health care (MHC) in developing countries has significant consequences for both the safe transition of the mother through pregnancy and child birth, and the survival and health of the child during early infancy (Khan 1987). Although antenatal care alone cannot prevent all obstetric emergencies (Vilar 1997), the information provided by the antenatal service provider on danger signs, diet, and planning for delivery, along with testing for anaemia, malaria and high blood pressure are important for the successful management of pregnancies and the subsequent wellbeing of the child.

Despite the benefits of MHC, many women in India do not receive pre-natal care at all, and the care that is received is often characterised by an insufficient number of visits timed late into the pregnancy (NFHS 1992/93). Furthermore, the delivery care utilised in India is dominated by home births either in the natal or the marital household. Hence, high risk pregnancies are often not identified, obstetric histories are ignored, opportunities for transmitting family planning messages are missed and important information on child nutrition and health care is not disseminated to a large proportion of mothers.

Previous literature has documented an urban-rural dichotomy in child health and survival and the utilisation of maternal health care in developing countries (Madise and Diamond 1996, Matthews and Diamond 1997, Stephenson 1998). Less is known about the variations in uptake, morbidity and mortality within urban areas although some authors have noted intra-urban disparities (Sen (1994), Harpham (1998) and Timaeus and Lush (1995)). Rates of infant mortality are much higher in poorer sectors of urban areas, and although a wide range of services often exist (including free Municipal providers), particularly in the Indian context, differential utilisation of MHC between urban socio-economic groups is suggested. Academic attention to social factors that affect health of poor urban dwellers is relatively new. Past research has tended to focus only on their physical environment. Diversity within rural areas is even less documented, although the potential for variation in rural service use is often constrained by a lack of infrastructure (Griffiths and Stephenson 1999).

India contains a significant proportion of the world's births, and like other developing countries, has experienced rapid growth in its urban population. Maharashtra in particular, which contains the megacity of Mumbai (formerly Bombay) and the Pune-Thane-Nagpur belt has rapidly developing urban populations and the commensurate diversities of morbidity, mortality and service use. Women living in the poorer areas of Maharashtra's urban settlements often have a choice of maternal and child health services that are not available to their rural counterparts. However, they can still be constrained in terms of uptake by social factors, as well as by a lack of financial resources and heavy workloads. Overcrowded conditions in slum pockets intensify women's social roles and lack of privacy (Ramasubban and Singh 1999). Dimensions of autonomy such as freedom of movement, decision-making power and control over finances can exert a strong influence over service use and service choice in the South Asian setting (Bloom et al 1998, Balk 1994). Further, women's links with natal kin, an important factor in both maternal and child healthcare seeking, can be compromised if migration to urban areas has been recent. The change from a rural to an urban setting, in terms of actual employment (see Boserup 1989), physical

conditions as well as social expectations of women, does not always support improved maternal and child health despite the availability of more services. The potential for seeking very poor quality care in these settings exists despite the availability of nearby high quality services.

The analysis presented in this paper uses data from the Indian National Family Health Survey (NFHS) 1992/93 to explore associations between socio-economic status, uptake of MHC and associated influence on nutrition and mortality. Although measures of women's autonomy have been documented elsewhere to be associated with antenatal care (see for example Bloom et al 1998) there is little information available in the NFHS data to measure many aspects of female autonomy. Female status is a difficult concept to measure (Mason 1986). However, limited proxies available to measure female status in the NFHS are used here including educational levels, knowledge of the local laws, knowledge of other health care practices, the age of the mother and the type of household in which a respondent resides.

The statistical analysis is preceded by a discussion of the current literature on the urban slum environment and health, and in particular women's health and health seeking behaviour. To examine the differences between socio-economic groups a standard of living index is created using variables collected in the NFHS. This index uses information on each woman's type of household, amenities and ownership of goods. The methodology used to construct this index is presented followed by a section discussing the use of survey data to model maternal and child health (MCH) outcomes. The use of antenatal care, the timing of the first antenatal care visit, the number of visits made and the place of delivery are explored. In addition, the use of these services is linked to two outcomes for the infant; neonatal mortality and nutritional status. Linear regression, logistic and multinomial regression analyses are applied to the data to identify socio-economic and demographic determinants of these outcomes. The final section collates the results from these models and recent related qualitative studies to provide a discussion of the link between location, socio-economic status and MCH outcomes.

BACKGROUND

The urban slum environment and health

Historically, development literature has focused on inequalities between poor rural and economically advantaged urban populations, and the linkages between urbanisation, the spread of capitalism and poverty. However, recent research in the 1980s and 1990s has revealed a great diversity in the extent and depth of poverty within the urban sector in developing countries. Harpham et al. (1988) argue that the depth of poverty is worse in deprived city slums than in rural communities. In the six years following the Alma Ata declaration on primary health care in 1978, the vision of primary health care and associated policy developments and literature was distinctly rural (Rossi-Espagnet 1984). The argument at that time was that the majority of the developing countries' populations lived in rural areas and urban groups were perceived as homogenous. Rossi-Espagnet (1984) challenged this view with two arguments to promote urban primary health care. The first was the rapid urbanisation of the developing countries. The second was the subsequent rapid growth in the urban poor and the inequity created within cities (Rossi-Espagnet 1984).

Rates of urban growth are most intense in developing countries, with many developing societies experiencing rapid increases in their urban populations in the past three decades. Urbanisation brings fundamental changes, both positive and negative, in the ways people live. Until the late 1970s and early 1980s urbanisation was viewed as invariably beneficial for improved health status as it resulted in better access to health services. However, studies which have examined the differentials in the health status or mortality rates between city districts (or municipalities) have shown that conditions in poorer areas are often worse than the more wealthy areas or the city average (Harpham et al. 1988 Rossi-Espagnet, 1984; Satterthwaite, 1993; Tabibzadeh et al., 1989). In some cities, maternal mortality and morbidity rates in low income districts may be higher than the city average if there is a low uptake of community based health care, pre-and postnatal services and emergency systems. In addition, infant mortality rates in poorer areas are often four or more times higher than in richer areas.

There are three groups of factors that are harmful to the health of the urban poor. The first includes the direct effects of poverty i.e. low income, limited education and insufficient diet. The second factor relates to the man-made conditions of the living environment including poor housing, overcrowding, pollution and an increased exposure to infectious diseases. The third factor involves social and psychological problems encompassing instability and insecurity (Harpham et. al. 1988). The excessive vulnerability of the urban poor and their exposure to pathogenic agents means that infectious diseases and malnutrition are severe health problems in slums. The socio-economically disadvantaged in general tend to be more vulnerable, both physically and economically, and this needs to be considered when interpreting environmental health differentials. With their greater levels of exposure to poor sanitation, overcrowded living conditions, inadequate nutrition, social stresses, exposure to environmental pollutants and limited access to health care, they are more likely both to get sick and suffer prolonged periods of illness.

For much of the developing world, growth in urban population is synonymous with growth in urban poverty, both in absolute and relative terms (Wratten,1995). The World Bank in 1988 estimated that the urban poor accounted for 25% of the urban population in the developing world and that “Increasingly, cities are becoming the world’s starkest symbol of the maldistribution of resources, both physical and societal.” (Wratten, 1995:11). These inequalities have serious impacts on the health of urban dwellers.

Economic motivations provide the main reason for migration from rural to urban areas. The rapid growth of cities is seldom matched by the demand for housing and other public services. Housing is a basic human need and an index of the socio economic progress of a country. In India, the housing shortage as of 1990 was estimated to be 33 million units, consisting of 10 million units in urban areas and 23 million in rural areas. In India, 35 to 40 % of the population cannot afford even the cheapest public constructed houses. The gap between housing needs and housing units required is so wide that if new houses are not constructed on a massive scale in the coming years, then an increasing percentrage of people will be forced to live in informal housing (Parmar, 1992).

Cheap housing areas and heavy industry both tend to be located on lower cost land sites and, in the absence of effective planning controls, this proximity can cause environmental problems. Hardoy and Satterthwaite (1991) estimate that at least 600 million of the urban

residents in developing countries live in health threatening homes and neighbourhoods characterised by inadequate housing, sanitation, water supply, drainage and health care.

The shortage of urban housing and the inability of the poor to pay even a minor sum for their shelter, result in the growth of large slums and squatter settlements. The Planning Commission in India (1983) estimated that 32 to 40 million people comprising 20 to 26% of the total urban population lived in slums. The slum population is concentrated in the twelve metropolitan cities, which account for 40% of the Indian population. Three quarters of the metropolitan slum population are concentrated in only four cities Mumbai, Calcutta, Madras and Delhi. In Mumbai, slum dwellers and the homeless account for over 50% of the city's population but they occupy only 6% of the city's land area (Geetha & Swaminathan, 1994). Slums are located typically in areas that are not meant for human habitation, for instance in low-lying areas, on hillsides, on marshy land and near rubbish dumps. In India, slums in low-lying areas collect stagnant water. Landslides seriously affect slums that are on slopes during the monsoon and residents have an increased risk of contracting malaria.

The man-made conditions of the urban environment cause particular health problems for the urban poor. Environmental pollution, which is a widespread problem for all urban people, affects the poorest more severely, since most of them live at the periphery of the city where manufacturing and processing plants are often built (Rossi-Espagnet, 1984). Biological pathogens in the urban environment represent the single most serious environmental problem in terms of their impact on human health (WHO, 1992). Waterborne diseases are the single largest cause of communicable diseases world-wide and account for more than 4 million infant and child deaths per year (WHO, 1992). Diarrhoeal diseases account for most water related infant and child deaths in urban areas, and a high proportion of illnesses. Risk factors include overcrowding, poor sanitation, contaminated water and inadequate food hygiene (Rossi-Espagnet, 1991).

There is increasing evidence for the role of social factors on health status in slum areas i.e. alienation, high rates of unemployment, ethnic tensions and urban poverty (Harpham, 1994, Harpham, 1997 and Werna et al., 1996). The social infrastructure and services (piped water, health services and housing) of the urban population has not kept pace with rapid growth (Satterthwaite, 1994). Rural-urban migrants may be exposed to greater risks as they may settle in environmentally and socially deprived areas alongside other migrants with similar risk and health seeking behaviours (Brockerhoff 1995). This has led to problems with defining urban poverty. Swaminathan (1995) argues that the standard measures of income are inadequate measures of deprivation. For example the poverty line that is used by the Planning Commission in India is unsatisfactory as it only looks at the expenditure on food consumption. Swaminathan (1995) argues that the measurement of non-food items and what constitutes a minimum non-food requirement should be included. Geetha and Swaminathan (1994) highlighted in their survey of a slum settlement in Mumbai, that there was no positive association between incomes and aspects of living standards such as the availability of clean drinking water and toilets. Satterthwaite (1994) also agrees that urban poverty should not be discussed in terms of income as it fails to pay sufficient attention to the social and health dimensions of poverty.

Psychological problems as a result of political, economic and social instability form another group of health problems for the urban poor. Many physical characteristics of the housing and living environment can influence the incidence and severity of psychosocial disorders.

These include noise, overcrowding, inappropriate design and the stresses and difficulties caused in any house or residential area when there is inadequate provision for sanitation, rubbish collection and maintenance. The nuclear or single parent family unit in the city generally replaces the protective structure of local communities and the extended family.

Even among the poor, certain groups are more susceptible to both biological and social risks than others. The very young and the very old tend to be more susceptible to infectious diseases. Urban women also face increased health risks, largely because of their social and economic roles, which expose them to greater numbers of environmental hazards. Women usually take primary responsibility for obtaining water and washing laundry. These activities can be hazardous where sanitation is poor, washing facilities are inadequate and water supplies are contaminated (Satterthwaite, 1993). Women are particularly at risk during pregnancy and after childbirth, being vulnerable to some chemical toxins and more susceptible to certain diseases such as malaria (Sims, 1994).

Yesudian (1988) found that the urban poor were not the major beneficiaries of the medical facilities in Mumbai. This was hypothesised to be due to the different nature of health needs of the urban poor, in comparison to the general urban population, and their inability to use many of these facilities on account of financial and administrative resources. Further, their health problems were highly linked with their lifestyle and environment. The urban medical services were not sensitive to these factors, and were therefore often irrelevant to the slum populations.

Yesudian (1988) suggested that slums are not homogenous entities. Central city slums of Mumbai have more permanent dwelling units with relatively better basic amenities, while slums in the periphery of the city have less permanent dwellings, and have evolved on under-developed sites. Socially some slums were homogenous, while others were heterogeneous. These lifestyles of the poor have obvious implications on their health status. Little research has been carried out to identify the linkage between lifestyle and maternal health problems or health service utilisation amongst the urban poor.

Yesudian (1988) suggested that unlike the rural poor, the urban poor have a variety of health services available to them in the city. The services available are tertiary-level teaching hospitals and ordinary dispensary services. In a study conducted in Mumbai, Yesudian (1988) found that slum communities sought private practitioners practising in slums for minor ailments; and for major complaints, they sought secondary or tertiary-level treatment centres. Kakar (1988) found a correlation between patients' socio-economic status and their use of western medicine, a finding that probably reflects the effects of education. Basu (1990) found that allopathic practitioners were considered superior to government doctors. People preferred private doctors for several reasons. It is generally assumed in India, that anything worthwhile or valuable will cost money; thus medical services that were paid for were seen as better than government services (Griffiths and Stephenson 1999). Practitioners who charged for their services were expected to be more polite and attentive and devote more care and concern to their patients. Studies are consistent in their findings about the dissatisfaction of government services including rude and improper behaviour by the health staff, staff shortages, and lack of supplies and drugs. Distance to services, time, charges and the behaviour of providers play a major role in making the urban poor's decision to seek health services.

Hence the literature has identified a range of factors operating in the urban slum environment at the aggregate level to influence health both physically and psychologically, especially for the poorest communities. However, there remains a lack of literature pertaining to differentials in health care utilisation in India, at an individual level, by socio-economic group within both urban and rural locations. The next section describes the relationship that exists between maternal health care and child survival. Additionally, factors previously identified by the literature to be associated with maternal and child health in the context of the study setting of Maharashtra are discussed.

Women and health-seeking behaviour

Mosley and Chen (1984) proposed a framework for the study of child survival in which they suggested five proximate determinants of infant mortality. Maternal factors including access to maternal health care services during pregnancy were identified as one of the key proximate determinants. The effect of maternal health care (or access to care) on the subsequent wellbeing and mortality risks in the early infant period has been documented in previous Indian studies (Beenstock and Sturdy 1990, Khan 1987). Environmental factors clearly play their part in affecting the health of both mother and child but where effective medical interventions for most conditions are known and available, the crucial factor is health seeking behaviours during health crises. Although any decisions to be made about healthcare choices are often made collectively, or by men, or older women within households in India (Dyson and Moore 1983, Griffiths 1998), attention for analyses of care-seeking must be focussed on pregnant women and mothers themselves. It is women's perceptions of health, disease and appropriate care that form the basis of decisions, and in emergencies they are the closest at hand to make such decisions.

Socio-economic variables such as education and employment are strongly related to uptake of services, and choice of 'safe' services in developing country settings (Stephenson 1998). Women from poor communities in urban areas in India are often not educated, of low caste and poorly paid. These factors in themselves compromise service use and subsequent maternal and child health. Aspects of women's autonomy such as freedom of movement, decision-making power, control over finances and support from natal kin can also be constrained in a slum setting although it is not clear to what extent. The status of women in slum families is low and this is likely to influence maternal health care use. Care seeking behaviours have been strongly associated with such factors in urban settings in India in previous studies (Bloom et al 1998, Ramasubban and Singh 1999). Nutrition, an additional but important factor determining the health of both pregnant women and children, is also socially constrained and associated with fasting norms and differential status of family members (Jordan et al cited in Vlassoff et al 1996). It should be noted also that care seeking for health problems related to childbirth and gynaecological conditions is likely to be determined by a different set of factors to service use for children's health problems.

Among the urban poor in Maharashtra, there is a very different choice of services than those available to rural women. There is a sophisticated service environment, particularly in Mumbai, and the Municipal system has a good record of preventing maternal mortality (Mumbai Municipal Corporation 1999), although there is evidence to suggest that levels of reproductive morbidity are high (Ramasubban and Singh 1999). Choices can be made, and decision-making in this context is likely to be based on complex interlocking factors. Slum populations themselves are very heterogeneous with the whole range of cultural

backgrounds that exist in India concentrated in closely positioned pockets of slum dwellers. Some women have recently migrated from rural areas, and many belong to linguistic groups that enable them to communicate with their neighbours in slum pockets but not necessarily with service providers. Poor areas in Pune and Nagpur and smaller urban areas are less heterogeneous, with more limited catchment areas, but also contain a range of religious, political and caste groups. These groupings are crucial in determining maternal care, as the differences in traditions surrounding place of delivery and care during pregnancy can be very diverse. For example, the practice of returning to the natal village for delivery of the first child and the extent to which modernisation has eroded this tradition are clearly key factors in care-seeking patterns. Beliefs surrounding the education of women can also vary markedly according to cultural and political group. Basu (1990) found that health care practices vary greatly by linguistic regions and caste group. Thus the motivations for care seeking are diverse, but the consequences for women and children important.

The study of health-seeking behaviour is now established, drawing on economic and social analyses, as well as models from health psychology. There have been a number of studies that focus on utilisation of maternal and child health care services within slum or deprived rural areas (eg Khan 1989, Prasad and Somayjula, 1992)**.** However, few compare women from urban and rural areas with varying standards of living. If we are to understand health in urban settings, where choice and quality are real issues, then maternal and child health services themselves, as well as factors which affect their differential uptake, should be examined more fully. Although the quality of services cannot be addressed via analysis of current DHS style surveys, factors associated with uptake can be identified, and differential uptake across urban and rural subgroups can be compared. This represents an analysis which cannot be undertaken through small scale survey work, and has the potential to increase understanding of uptake in more deprived areas**.**

The next sections examine the effects of poverty on access to MCH services, linking the use of these services to two outcomes for the infant; mortality and nutritional status in Maharashtra. Preceding this analysis, the following section describes the construction of a standard of living index using survey the NFHS survey data.

CONSTRUCTING A STANDARD OF LIVING INDEX

The Maharashtra National Family Health Survey 1992/93 (NFHS) interviewed a representative sample of 4,106 ever-married women aged 13-49 from 4,063 households. The survey collected information on a number of socio-economic variables for women living in rural and urban areas. To examine the differences between the different socio-economic groups, urban and rural cases within the survey data set are separated. Wealth variables that are used to construct the standard of living index are placed in an urban or rural context. Social indicators often have a different interpretation depending on the location in which the respondent is living. For example, the ownership of agricultural land or livestock is an important indicator of an individual with high socio-economic status in a rural area, although a respondent living without access to these things in an urban area could not necessarily be described as socio-economically deprived. Urban dwellers would not commonly own livestock or agricultural land regardless of their standard of living. A review of the literature has failed to find a commonly used single index for measuring standard of living in rural and urban areas. Studies by Govindasamy and Ramesh (1997)

and Stephenson (1998) have used standard of living indices but have not taken into account the urban bias of certain variables in their construction.

The index used here is created using variables from the NFHS relating to the household structure, resources available in the household, ownership of consumer goods and agricultural land. A list of the variables used to create the index can be found in Appendix A. Each category of a variable is scored to indicate its association with socio-economic status separately for urban and rural locations.

For each variable the modal category in each location is given a score of two and the other categories are given scores which ranged from zero to five. The other scores are assigned by weighting the importance of the other categories of the variable to socio-economic status. This is completed using the frequency distribution for each category of the variable and the authors' previous research experience in urban and rural areas of Maharashtra coupled with information from recent literature relating to indicators of socio-economic status. This is used to establish whether a category is associated with higher or lower socio-economic status. Consequently, five represents a higher socio-economic status and zero is the lowest socio-economic status.

The variables used for the creation of the standard of living index are found in the table in Appendix A. The scores are totalled for each household. The categories for urban areas are computed as follows: low (26-38) medium (39-44) and high (45-68). In rural areas: low (38-45) medium (46-49) and high (50-93). The index therefore presents a relative measure of standard of living for each household in the data set and is not intended to define households as poor or rich. The data collected in the NFHS is not detailed enough to create an index measuring poverty as it does not illicit information on key variables such as income. Producing a relative index allows the modelling of associations between the three groups identified for each area and maternal and child health outcomes. The next section introduces the methodology used for the analysis of the Indian National Family Health Survey (NFHS) 1992/93. This analysis explores associations between socio-economic status, child nutrition and mortality, and use of MHC.

USING SURVEY DATA TO LINK STANDARD OF LIVING WITH MATERNAL CARE

Previous sections have demonstrated a dearth of literature pertaining to differentials in health care utilisation in India, at an individual level, and by socio-economic group within both urban and rural locations. The Maharashtra NFHS data provide a representative sample of the population and presents a unique opportunity to assess the use of maternal and child health care use at an individual level in the state. Maharashtra is the most urbanised state in India and hence provides an interesting example to study urban/rural differentials in health care utilisation by standard of living in India.

The National Family Health Survey 1992/93 (NFHS) collected information on antenatal care for all children born to respondents since January 01st 1988. There were 2597 births which occurred to mothers in these years in Maharashtra. These births include children who were alive at the survey date and those who died before the survey took place. The following section describes the motivations for the outcome variables used in the maternal health care models.

Analyses of maternal health care indicators

To explore the effect of poverty on maternal health care utilisation, the standard of living index as described previously is calculated for each woman in the Maharashtra NFHS and its association with health care uptake is investigated. Clearly those who fall into the low economic status group in both urban and rural areas include those living in poverty, but no poverty line is implied by the boundary of this group, the cut-off points are arbitrary. Further, the lower standard of living category is not necessarily identical to the slum population within urban areas, but is expected to contain a large proportion of slum dwellers. However, to chart the associations between these categories and health care use necessarily addresses the effects of relatively low economic status on care-seeking behaviours.

The WHO estimates suggest that 88-98% of pregnancy-related deaths are avoidable (1996). Bhatia (1993) reported that 78% of maternal deaths occurring in a study population in South India were preventable by timely intervention. Hence, providing quality health care during and after labour and delivery is the single most important way of saving the lives and preserving the health of mothers and babies (WHO, 1996). Antenatal care provides the opportunity for complications to be detected and gives women advice on the management of complications (Abou Zahr, et al., 1996).

An important issue in the delivery of antenatal care is the timing of the initial contact. MacDonald and Pritchard (1980) suggest that a woman should receive a check-up every four weeks from the sixth week of pregnancy to the seventh month of gestation, then every two weeks for the eighth month and every week throughout the ninth month. Park and Park (1989) also recommend a minimum acceptable schedule of visits, which requires one visit in the 3rd, 6th, 8th and 9th month of pregnancy. In Maharashtra, 82% of the mothers in the NFHS survey had received antenatal care (IIPS, 1994). The NFHS reveals that 31% of these women were not seen until the third trimester (IIPS, 1994). This delay substantially reduces the usefulness of antenatal care, which is not being utilised early enough to identify high risk pregnancies that need special treatment (WHO, 1996). In the urban context, women are close to health services and awareness of appropriate professional help at the time of delivery may be attained through antenatal care.

The outcome variables studied in this analysis allow the identification of non-use of antenatal services. Additionally, amongst those respondents who do utilise the service, the women who either initiate antenatal care use too late in pregnancy or who do not receive care frequently enough can also be identified. Thus the three outcomes modelled are:

i) Use versus non use of antenatal care;
ii) Timing of first antenatal care visit and;
iii) Frequency of antenatal care visits

Women who have had only 1-3 visits are categorised together, representing one risk group, while those with their first antenatal visit in their third trimester represent another. Thus following the guidelines suggested by Park and Park (1989) women who receive too few antenatal care visits timed inappropriately within their pregnancies can be identified and the risk factors associated with these modelled.

Of the women who seek antenatal care in Maharashtra, 61% receive that care from a doctor, 13% from a health worker within the home, 8% from another health professional, and 1% from another source. Therefore the majority of women who receive antenatal care receive it from a trained health worker. Hence this factor is not modelled as an outcome, although the factors associated with no use of antenatal care from a health care professional are studied in the model which considers antenatal care use against non-use.

Maternal mortality in India is estimated at 570 maternal deaths per 100,000 live births (WHO, 1996). This reinforces the importance of ensuring that deliveries take place under the supervision of medical personnel in a hygienic environment. Each year in India, only 35% of deliveries take place with the help of a doctor or midwife (WHO, 1996). In Maharashtra, 56.5% of the women delivered at home (35.9% at the respondents' home, 20.6% at parents and other home), compared to 75% in the total Indian population (IIPS, 1994). The figure for the uptake of institutional deliveries in Maharashtra (43%) is much higher when contrasted to India as a whole (26%), given the relatively developed state of Maharashtra, it compares unfavourably to rates found in Kerala (88%) and Goa (87%) (IIPS, 1994). Delivery care is an important aspect of maternal care. Most non-abortion maternal deaths occur around the time of labour or delivery or within the few days after delivery (World Bank, 1996). Access to obstetric services from qualified health professionals is therefore essential in preventing maternal deaths. Urban poor women in Maharashtra have a choice of maternal and child health services that are not available to their rural counterparts. Previous studies have examined place of delivery in urban slum areas (Basu, 1990; Yesudian, 1988) however, very few have examined women from urban and rural areas with varying standards of living.

Place of delivery is therefore modelled as another outcome with standard of living as an explanatory factor and controlling for other social and demographic variables. First births are analysed separately as they are believed to be different from higher parity births given the cultural norm for mothers in Maharashtra to visit their parents' home for the first child's birth (Hutter, 1994). The place of delivery is categorised as marital home, other home, government hospital or private hospital.

Preliminary statistics on all of these indicators are presented in Table 1. Clearly, India has a better coverage of maternal health services for women who have received antenatal when compared to Pakistan and other surrounding countries such as Nepal and Bangladesh. However, within India, the inter-state variations are substantial. The percentage of births for which mothers did not receive antenatal care ranges from 54.5% in Uttar Pradesh to 1.9% in Kerala, with Maharashtra falling in between with 17%. The effects of residing in an urban area are also evident. As an aggregate for the whole of urban India 17.8% of the women did not receive any kind of antenatal care, which is almost 20% less than the figure for the urban and rural populations combined, indicating to a clear urban-rural differential in favour of urban dwellers. In Maharashtran urban areas the same pattern is seen, with urban rates of non-utilisation considerably lower than for the whole state. However, when focussing on the urban poor in Maharashtra using the standard of living index, the position is reversed with an increased percentage of non-use as compared with the aggregate urban population. These patterns are also seen for late and infrequent antenatal visits, with later initiation of prenatal care and fewer visits during the pregnancy among the urban poor when compared to the total urban population.

An important element of MHC services is to encourage institutional deliveries under the supervision of trained health professionals. The majority of maternal deaths and morbidity resulting from childbirth are due to the failure of getting timely help for complications at delivery. Table 1 shows that in India 75% of the births took place at home either at the woman's own home or in the parents' home. There are also large interstate variations in the proportion of home deliveries ranging from the lowest in Kerala to the highest in Uttar Pradesh with Maharashtra, again falling in between. In urban areas the home birth rate is of course much lower, but among those with a low standard of living the percentage is more than 50% higher than the total urban figure.

In terms of delivery location and antenatal care, parity can play an important part in the Indian context because of the traditional practice of having a first baby in the natal village. When examining urban/rural differentials this is a key factor to consider. In India and Pakistan a large proportion of first births take place at home. The interstate variations for the percentage of first births taking place at home are considerable. Some effect of the urban environment in the utilisation of health institutions for child delivery for first births is evident. Of the women in the low socio-economic group in urban Maharashtra, 38.4% delivered their first child either at their own home or at their parents' home compared to 20.1% for the aggregate urban population and 45.1% for the total population of Maharashtra. This suggests that the urban poor have lower service utilisation for delivery than the aggregate urban population, although they have higher use than the total state population.

The statistics presented in Table 1 suggest that the urban poor in Maharashtra are disadvantaged in their access to MHC services when compared to the entire urban population of the state. However, the statistics presented in these tables do not allow for other potential influences on use of maternal health services to be controlled for. The NFHS has information on a number of other variables that have the potential to be associated with use of MHC. The use of regression analysis allows these factors to be controlled for whilst also measuring the effect of the standard of living in rural and urban areas. The next section introduces the regression modelling techniques used.

Table 1
Indicators of maternal health care by location and standard of living

		Of those with a/n care		
LOCATION	Percentage with no antenatal care	Percentage with 1st antenatal visit in 3rd trimester	Percentage with only 1-3 antenatal visits	Percentage home deliveries
National and regional				
India	36.8	18.0	56.1	75.0
Pakistan	69.6	26.6	43.8	85.2
Uttar Pradesh	54.5	19.6	77.8	87.7
Kerala	1.9	7.2	9.5	11.4
Maharashtra	*17.2*	*31.0*	*50.5*	*55.7*
Urban areas only				
India	17.8	17.5	42.3	42.0
Pakistan	39.6	-	-	66.5
Uttar Pradesh	29.3	15.7	63.6	65.4
Kerala	0.5	6.3	8.4	4.6
Maharashtra	*10.7*	*37.9*	*41.7*	26
Maharashtra (low standard of living)	*18.0*	*52.2*	*60.1*	42
1st births only				
India	26.2	-	-	60.8
Pakistan	63.8	-	-	78.3
Uttar Pradesh	43.7	-	-	79.0
Kerala	0.2	-	-	5.0
Maharashtra	*21.1*	29.5	45.4	*45.1*
Maharashtra urban	*9.8*	36.3	33.9	*20.1*
Maharashtra urban (low standard of living)	*12.8*	12.1	60.0	*38.4*

Determinants of antenatal care

The NFHS sample contains information for each individual child rather than for each woman in the survey population. This means that in households where more than one child was born in the period from January 1st 1988 to the date of the survey, there may be information for more than one child for each woman. Table 2 below shows the uptake of prenatal care, firstly for women who have had three pregnancies in the sample and secondly for those who have information for two pregnancies. The information is also restricted to those who have had a first birth in the last five years. An examination of the data without controlling for any other factors reveals that women who adopt antenatal care for one birth are most likely to continue to use the service for following births. Similarly, women who do not use the service for a first birth are likely to continue not using the facilities. Table 2 reveals that women tend to adopt the same pattern of prenatal care utilisation for

subsequent births as first births. It was therefore decided to model the uptake of antenatal care for first births using the logistic regression model presented below. Factors that predict use of prenatal services for first births will be good indicators of a woman's behaviour for subsequent births, given the information presented in Table 2.

Table 2
Patterns of uptake of antenatal care for multiparous women

Pattern of uptake of Antenatal Services	Maharashtra
Women with three births*	
Yes, yes, yes	38
Yes, yes, no	2
No, yes, yes	1
Yes, no, yes	3
Yes, no, no	3
No, yes, no	0
No, no, yes	0
No, no, no	7
Women with two births	
Yes, yes	217
No, no	20
Yes, no	18
No, yes	13

* starting with the first birth
Source National Family Health Survey 1992/93

A logistic regression was fitted for first births using a dichotomous dependant variable which measures whether a woman has antenatal care or no antenatal care. The model fitted took the following form:

$$\ln(p/1\text{-}p) = a_0 + a_1 x_1 + a_2 x_2 + \ldots . a_k x_k$$

where

p = probability of obtaining antenatal care

a_0 a_1 , . . . a_k are regression coefficients

x_1 , x_2 … x_k are explanatory covariates

Each of the variables shown in Appendix B were entered into the logistic model for use of antenatal care for first births. The results of the most parsimonious model are presented in Table 3. The probability of accepting antenatal care was calculated by setting the other covariates entered into the model to their mean values in the sample and entering the appropriate parameter values for the variable of interest. The variable that measured crowded living conditions was included as a continuous explanatory variable in the model. In the results table the probability of use of prenatal care is displayed for those living in households with 1, 4 and 7 persons per room. These estimates represent the plausible range of crowded living conditions displayed among the respondents. Variables which were found to be significant in predicting use of antenatal care for first births were the number of months before the survey that the child was born, the degree of household crowding, the respondent's knowledge of the legal age of marriage, the respondent's knowledge of oral rehydration salts, respondent's educational status, religion and Standard Of Living Index (SLI).

The three variables which produce the largest difference in the probability of receiving prenatal care are the number of months before the survey that the child was born, the respondent' s educational status and the SLI. Of the first births that were born more than 36 months before the survey date, there was a 0.87 probability of them receiving prenatal care. However, first pregnancies born within the 36 months before the survey had a probability of 0.95 of receiving prenatal care. This suggests that the coverage of antenatal care services improved in the five years prior to the NFHS in Maharashtra.

Women who had received some form of schooling also had a higher probability of using antenatal care services than illiterate respondents. Women who had received no education had a probability of 0.86 of using prenatal care compared to 0.95 for those with at least a primary school education. Two other variables related to the respondent's knowledge were also associated with the probability of receiving prenatal care. Respondents who knew the minimum legal age of marriage for females in India had a higher probability of receiving antenatal care than those who did not know the answer to this question. Knowledge of the legal age of marriage is a measure of a woman's current familiarity with rules and regulations relating to her wider living environment. Also those respondents who knew about oral rehydration salts (ORS) had a higher probability of using prenatal care. However, this variable is potentially difficult to interpret because it is possible that women find out about ORS when they go for a prenatal check-up. This means it is impossible to say whether a woman's knowledge of ORS is likely to increase her chances of receiving prenatal care or whether the prenatal care increased her probability of knowing about ORS. However, the significance of the other two variables relating to a woman's knowledge suggest that awareness of community rules and educational attainment are important determinants of prenatal care use in Maharashtra.

The SLI variable also produced a large difference in the probability of use of antenatal care. No statistically significant difference in the probability of use of antenatal care was observed between women living in urban areas of different socio-economic status. This is consistent with the findings presented in Table 1 which showed that there was little difference in use of antenatal care for first births between low socio-economic urban dwellers and the aggregate urban group. The two higher socio-economic groups in rural areas also showed no significant difference in the use of prenatal care to those living in urban areas with higher socio-economic status. However, the most disadvantaged in the rural areas were found to have a statistically significant difference in their utilisation of antenatal care (probability of 0.85) when compared to those living in the highest socio-economic group in urban areas (probability of 0.96). Therefore, the results shown here suggest that those living in the rural lower socio-economic groups are the least likely to receive antenatal care for first births, although the probabilities show that even this sub group of women had a high use of prenatal care services.

Table 3 shows that there is very little difference in the probability of use of prenatal care, even for the significant variables entered into the model. This is because use of the service for first births in the state is almost universal. This suggests that the state of Maharashtra has largely been successful in ensuring that pregnant women have access to at least one antenatal care check-up. However, the Indian government's 1992 Child Survival and Safe Motherhood Programme not only aimed to provide antenatal care but also to ensure that women were provided with 3 prenatal care visits spaced appropriately throughout the pregnancy (NFHS 1992/93). In the following section the pattern of antenatal care use is investigated, focussing upon the timing and number of antenatal care visits received by women in Maharashtra.

Table 3[1]
Probability of using antenatal care for first births

Variable	Number	β	Standard Error β	Probability of use of antenatal care
Constant	774	5.2905	0.6709	-
Child's Age				
< 36 months	468	Reference	-	0.95
36 months plus**	306	-0.9882	0.2515	0.87
Crowding*		-0.1165	0.0471	
1 person per room	57	-	-	0.95
4 persons per room	128	-	-	0.92
7 persons per room	36	-	-	0.90
Knowledge of legal age of marriage				
18 plus years	489	Reference	-	0.94
<18/don't know*	285	-0.6003	0.2853	0.90
Respondent knows of ORS				
Yes	320	Reference	-	0.95
No**	454	-0.8627	0.2843	0.90
Respondent's education				
Primary Plus	477	Reference	-	0.95
Illiterate**	297	-1.2011	0.3193	0.86
Religion				
Other	709	Reference	-	0.93
Buddhist*	65	1.1581	0.5186	0.98

In Tables 3-8 ** denotes that the variable was significantly different to the reference category at the 1% level
* denotes that the variable was significantly different to the reference category at the 5% level
⊥ denotes that the variable was significantly different to the reference category at the 10% level

Table 3 Continued
Probability of using antenatal care for first births

Standard of living				
Urban high[ns]	139	Reference	-	0.96
Urban medium[ns]	104	-0.6637	0.7204	0.93
Urban low[ns]	160	-0.4747	0.7404	0.94
Rural high[ns]	120	0.7999	0.6862	0.92
Rural medium[ns]	165	-0.6999	0.7039	0.93
Rural low[*]	86	-1.5438	0.6775	0.85

Determinants of antenatal care timing, frequency and place of delivery
The timing and frequency of antenatal care visits along with the place of delivery were modelled using multinomial logistic regression models to investigate the effects of standard of living using the following equation:

$$\ln(p_1/p_3) = a_0 + a_1 x_1 + a_2 x_2 + \ldots . a_k x_k$$

$$\ln(p_2/p_3) = b_0 + b_1 x_1 + b_2 x_2 + \ldots . b_k x_k$$

where

a_0 , $a_1 \ldots a_k$, b_0, b_1, ..b_k, c_0, $c_1 \ldots c_k$

are regression model parameters

x_1, $x_2 \ldots x_k$ are explanatory covariates

and, for antenatal care timing

p_1 = probability of receiving antenatal care in the first trimester

p_2 = probability of receiving antenatal care in the second trimester

p_3 = probability of receiving antenatal care in the third trimester

for antenatal care frequency

p_1 = probability of having 1-3 antenatal care visits

p_2 = probability of having 4 antenatal care visits

p_3 = probability of having 5 or more antenatal care visits

For place of delivery the model fitted was in the form:

$$\ln(p_1/p_4) = a_0 + a_1 x_1 + a_2 x_2 + \ldots . a_k x_k$$

$$\ln(p_2/p_4) = b_0 + b_1 x_1 + b_2 x_2 + \ldots . b_k x_k$$

$$\ln(p_3/p_4) = c_0 + c_1 x_1 + c_2 x_2 + \ldots . c_k x_k$$

where

p_1 = probability of delivering at parents or other home

p_2 = probability of delivering at a gvt. hospital

p_3 = probability of delivering at a private hospital

p_4 = probability of delivering at respondents home

and

a_0 , $a_1 \ldots a_k$, b_0, b_1, ..b_k, c_0, $c_1 \ldots c_k$

are regression model parameters

x_1, $x_2 \ldots x_k$ are explanatory covariates as in the previous models

The resulting estimated probabilities are shown in Table 4 below.

Table 4
Estimated probabilities of maternal health care outcomes by location and economic status[2]

Location	Urban			Rural		
Economic status	Low	Medium	High	Low	Medium	High
First antenatal visit						
1st trimester	0.29**	0.26**	0.40	0.29	0.34⊥	0.34
2nd trimester	0.25**	0.19**	0.23**	0.45	0.47	0.38
3rd trimester	0.46	0.55	0.37	0.27	0.20**	0.28
Number of antenatal visits						
1-3 visits	0.54	0.44	0.34	0.67	0.65	0.61
4 visits	0.15*	0.17**	0.14**	0.11	0.08	0.09
5 visits or more	0.31	0.39**	0.51**	0.22⊥	0.26	0.30
Place of delivery: 1st births						
Home	0.19	0.12[3]	0.12	0.30	0.19	0.19
Parents or other home	0.21	0.17[4]	0.17	0.30	0.29[5]	0.29
Government hospital	0.46	0.36	0.36	0.19	0.29[6]	0.29
Private hospital	0.14	0.36	0.36	0.20	0.23	0.23
Place of delivery: 2+ births						
Home	0.42	0.23	0.23	0.61	0.54	0.54
Parents or other home	0.05**	0.15[7]	0.15	0.22*	0.25[8]	0.25
Government hospital	0.42⊥	0.35	0.35	0.10**	0.15**	0.15**
Private hospital	0.12**	0.27	0.27	0.06**	0.07**	0.07

2 Table 4 presents the simplified version of the results from the multinomial models. The reader should refer to Appendix C to see parameter estimates, standard errors and numbers in each category for all variables entered into the most parsimonious model.

3 The urban medium and high categories were collapsed as they show the same association with home deliveries for first births

4 The urban medium and high categories were collapsed as they show the same association with parents or other home deliveries for first births

5 The rural medium and high categories were collapsed as they show the same association with parents or other home deliveries for first births

6 The rural medium and high categories were collapsed as they show the same association government hospital deliveries for first births

7 The urban medium and high categories were collapsed as they show the same association with parents or other home deliveries for 2+ births

8 The rural medium and high categories were collapsed as they show the same association with parents or other home deliveries for 2+ births

The estimated probabilities of maternal health outcomes from the multinomial modelling are shown in Tables 4 and 5. Table 4 shows that education, employment and socio-economic status by residence have significant effects on the timing of the first antenatal care visit. As the levels of the Standard of Living Index (SLI) increase, the probabilities of having antenatal care in the first trimester also increase. For urban women in the low and medium SLI groups, the probability of receiving antenatal care in the last trimester is much greater than for women in the high SLI group. The urban low SLI women have a probability of 0.46, the medium group slightly higher at 0.55 and the high group significantly lower at 0.37 of having the first antenatal visit in the third trimester.

Urban residence and education are also significant factors in determining the number of antenatal care visits received. Table 4 shows that the low SLI group have a 0.54 probability of receiving less than 3 antenatal care visits. In contrast, for the high SLI group, the probability of receiving less than 3 visits is 0.34. The probability of receiving 5 or more antenatal care visits is 0.51 for the high urban SLI group and 0.31 for the low urban SLI group. The probabilities of receiving more than three antenatal care visits in rural areas are very small for all socio-economic groups. All socio-economic groups in the rural areas show high probabilities for 3 or less antenatal care visits: rural low SLI (0.67), rural medium SLI (0.65) and rural high SLI (0.61).

Table 5 shows that education and employment are significant in the timing of the first antenatal care visit. As the levels of education increase the probability of obtaining antenatal care in the first trimester also increases. Women with high school education or above have a high probability (0.60) of receiving antenatal care in the first trimester. For illiterate women the probability of obtaining antenatal care in the first trimester is 0.22 . Women who are employed have a low probability of acquiring antenatal care in the first trimester (0.29).

Education had a significant effect on the number of antenatal care visits. Illiterate women show a probability of 0.62 of receiving less than 3 antenatal care visits whereas women with high school education or above display a probability of 0.35. From Table 5, the figures show that as the levels of education increase the probabilities of 5 or more antenatal care visits also increase.

The model for place of delivery for first births indicates that standard of living by residence does not have a significant effect on place of delivery, although education and employment do. For subsequent births, standard of living by residence, education and employment were all significant factors in predicting place of delivery. For first births urban residence was observed to be important for institutional deliveries. The urban low SLI women have a high probability (0.46) of delivering at the government hospital (see Table 4). They have similar probabilities of delivering at their own home (0.19) and at their parents or other home (0.21). However, this changes for children of higher parities, the probability of delivering at their own home is 0.42. Urban women from medium and high socio-economic backgrounds have similar probabilities for utilising government and private hospitals for both first and subsequent births. The probability of rural low SLI women delivering at an institution for both her first birth or higher order births is very low. The probability of delivering in a government hospital for rural low SLI women is 0.19 for first births, which decreases to 0.10 for subsequent births. The probability of a home delivery at the respondent's home for rural low SLI women is high for first births (0.30) and subsequent births (0.61). Rural

women from medium and high socio-economic backgrounds have slightly higher probabilities of using institutions for their first births in comparison to the rural low SLI women, although institutional deliveries decline for subsequent births.

Education has a significant effect on the utilisation of institutions for the delivery of higher order births. Women with any kind of schooling showed a higher probability of utilising an institution for childbirth than illiterate women. For first births, as the level of education increases, the probability of delivering at home decreases. Employment also has a significant effect on first and higher order births. The probabilities for women who were not employed are slightly higher in utilising health institutions for both first and subsequent births compared to employed women. For first births, employed women have the same probabilities of childbirth taking place at their own home (0.28), parents/other home (0.28) and government hospital (0.28). Women who were not employed have slightly higher probabilities of utilising the government hospital (0.32) and private hospital (0.31) for the birth of the first child compared to women who do work. This pattern was also observed for subsequent births.

This section has shown a clear association between the use of MHC and SLI combined with location of residence. The following section aims to model the association between health outcomes for the child in the early period after birth; using neonatal mortality and infant nutritional status as outcomes. These outcomes are again modelled using the SLI and place of residence as explanatory variables and controlling for the use of MHC. These models are introduced in the following section.

Table 5
Estimated probabilities of maternal health care outcomes by women's characteristics[9]

Women's characteristics	Illiterate	Literate with primary education	Literate with middle school education	Literate with high school education+	Employed	Not employed
First antenatal visit						
1st trimester	0.22	0.32**	0.39**	0.59**	0.29**	0.36
2nd trimester	0.35	0.31	0.34*	0.22⊥	0.31*	0.33
3rd trimester	0.43	0.37	0.27	0.19	0.41	0.31
Number of antenatal visits						
1-3 visits	0.62	0.57	0.50	0.35	0.67	0.47
4 visits	0.13	0.11	0.10	0.12	0.09	0.13
5 visits or more	0.25	0.31	0.40	0.53	0.24	0.40
Place of delivery: 1st births						
Home	0.22	0.18	0.14[10]	0.14	0.28	0.14
Parents or other home	0.36	0.25	0.14[9]	0.14	0.28	0.22
Government hospital	0.29⊥	0.28	0.32	0.32	0.28**	0.32
Private hospital	0.13**	0.29*	0.40	0.40	0.16**	0.31
Place of delivery: 2+ births						
Home	0.52	0.46	0.39	0.39	0.50	0.47
Parents or other home	0.22	0.15*	0.13	0.13	0.22	0.16
Government hospital	0.18	0.25**	0.23*	0.23*	0.19⊥	0.23
Private hospital	0.07	0.14**	0.25**	0.25	0.09*	0.13

9 Table 5presents the simplified version of the results from the multinomial models. The reader should refer to Appendix C to see parameter estimates, standard errors and numbers in each category for all variables entered into the most parsimonious model.

10 The literate with middle school education and literate with high school education plus categories were collapsed as one category as they showed the same association with home deliveries for first births

ASSOCIATED INFLUENCES ON INFANT MORBIDITY AND MORTALITY

The effects of low standard of living on MHC use are clearly shown by the previous analysis. These influences are net of other social and demographic factors such as women's education and employment. Associated influences of standard of living on infant mortality and morbidity have been suggested by previous research. Adverse effects of poor, late and infrequent uptake of antenatal care and home deliveries have been particularly noted in connection with neonatal mortality outcomes (Beenstock and Sturdy, 1990 and Stephenson, 1998). In this section the effect of standard of living and place of residence and the use of antenatal care on infant health and mortality outcomes are modelled using child health and mortality outcomes whilst controlling for other social and demographic variables.

Mosely and Chen (1984) show that infant health outcomes are strongly linked to mortality if a child is not given adequate nutrition and medical intervention during a disease episode. Mortality is an easily defined and measurable event that can be investigated using the NFHS survey data. Neonatal mortality in particular is an important outcome in relation to maternal health care factors. Previous studies of the all India NFHS data have shown that the place of delivery, antenatal care use, and frequency and timing of visits are associated with neonatal mortality outcomes, but not with later mortality outcomes (Stephenson 1998). The death rate is at its highest in the neonatal period in Maharashtra resulting in a large enough number of cases of mortality in the five years preceding the survey to be able to carry out a feasible regression analysis for this outcome.

The prevalence of ill-health among children is more widespread than mortality, and is potentially also linked with maternal health care outcomes and standard of living. However, the choice of indicators available in the NFHS for measuring child morbidity is limited to illness episodes such as fevers and coughs within the two weeks preceding the survey which are reliant upon the respondent's accurate identification and recall. The NFHS also measured the weights and heights of children under the age of four at the time of the survey, providing information on child nutritional status. These values can be converted into z-scores by comparing the anthropometric measures using the child's age to the National Centre for Health Statistics (NCHS) international reference population. The measurement of an infant's nutritional status is a precise measure of a child's current and past healthiness and does not rely on recalled and possibly imprecise information regarding disease incidence in the same way as the other NFHS morbidity indicators. Further, changes in z-score during the first year of life often set the scene for nutritional wellbeing throughout childhood (Madise and Mpoma 1997).

Table 6 shows the expected relationship of urban mortality and nutritional status with urban location such that urban dwellers do better on both counts than the overall population. This association is also observed for surrounding countries such as Bangladesh and Pakistan as well as for other states within India. However, in Maharashtra, where the urban low standard of living group is studied separately, it is clear that both neonatal mortality and child nutritional status outcomes are more adverse than for the aggregate urban population or the state estimate that combines values for urban and rural populations.

Table 6
Neonatal mortality and nutritional status by location and standard of living

LOCATION	% below 3 sds from mean WAZ (under 4 yrs)	Neonatal mort rate per 1000
National and regional		
India	20.6	52.7
Pakistan	13.7	53.3
Uttar Pradesh	19.2	69.8
Kerala	6.1	22.1
Maharashtra	*20.2*	*37.7*
Urban		
India urban	14.8	35.5
Pakistan urban	9.5	38.9
Uttar Pradesh urban	16.7	36.7
Kerala urban	2.7	19.2
Maharashtra urban	*14.6*	*31.4*
Maharashtra urban: low economic status	*24.4*	42.3

Nutritional status

Linear regression is used to investigate further the association between the standard of living and the nutritional status of the child during the first year of life. This analysis is limited to children who were alive at the time of the survey and available to have their weights recorded. The United Nations software package; "ANTHRO" is used to calculate weight for age z-scores using the information collected in the NFHS on weights and ages of children. Weight for age is the chosen measure for observing nutritional status because it takes account of both acute and chronic malnutrition. However, it does not allow us to establish whether the child has a low weight because of a chronic nutritional deficiency or an acute one, although low weight is evidence that one of these problems exists. Including only children aged 1-11 months at the time of the survey means that only one child from each household is included in the analysis. The multiple linear regression model is of the form:

$$WAZ = a + b_1 x_1 + b_2 x_2 + \ldots b_n x_n + \varepsilon$$

where WAZ = weight for age z score,
and a, b_1 , . . . b_k are regression coefficients
x_1 , x_2 … x_k are explanatory covariates

Each of the variables shown in Appendix D is entered into the model for predicting weight for age z-scores. The results of the most parsimonious model are presented in Table 7. The adjusted weight for age z-scores presented in the table are calculated by setting the other covariates entered into the model at their mean values in the sample and entering the appropriate values for the variable of interest. Variables which are found to be significantly

associated with weight for age z-score in the analysis for children ages 1-11 months in Maharashtra are the child's age, the mother's age, the size of the baby at birth and the standard of living index.

Table 7
Results of a linear regression model to predict weight for age Z-score for infants

Variable	Number	β	Standard Error β	Adjusted WAZ
Constant	391	0.3501	0.1796	-
Child's age**	-	-0.1863	0.0184	-
1 month	38	-	-	-0.37
3 months	47	-	-	-0.75
5 months	34	-	-	-1.12
7 months	25	-	-	-1.49
9 months	21	-	-	-1.87
11 months	24	-	-	-2.24
Size of baby at birth				
Average	245	Reference	-	-1.14
Large*	54	0.3754	0.1644	-0.77
Small**	91	-0.4314	0.1347	-1.57
Mother's age				
< 30 years	368	Reference	-	-1.16
30 plus years*	23	-0.5951	0.2360	-1.75
Standard of living index				
Urban high	54	Reference	-	-0.74
Urban mediumns	53	-0.2958	0.2104	-1.03
Urban low**	53	-0.6215	0.2107	-1.36
Rural highns	73	-0.2550	0.1951	-0.99
Rural medium**	80	-0.7818	0.1912	-1.52
Rural low**	78	-0.6117	0.1925	-1.35

The youngest children in the sample are found to have the highest weight for age z-scores whilst the older children have lower weight for age z-scores. Children who are born to mothers over the age of 30 years are more likely to have lower weight for age z-scores than those born to younger mothers. However, the most significant factors in this model are the size of the child at birth and the standard of living index. Children who are described to be small at the time of birth are likely to continue to have lower weight for age z-scores throughout the first year of life. Conversely, those whom their mother describes to be large at the time of birth continue to have higher weight for age z-scores than their counterparts who are described to be of an average size at the time of the birth. However, this variable relies on the respondent's accurate recall of the size of her infant at the time of its birth. It may be that mothers who currently have underweight infants are more likely to remember their infants as small at the time of birth than mothers who currently have average or large sized infant.

In accordance with the findings from the earlier models for maternal health care, the standard of living index is found to be associated with the nutritional status of infants in Maharashtra, suggesting that socio-economic status and type of living environment are also important in predicting weight for age z-scores. As can be seen from Table 7 women living in urban high and medium groups as calculated from the standard of living index (SLI) and those living in the rural high socio-economic group are not found to have significantly different weight for age z-scores. However, those living in the rural low and medium SLI groups and the urban low cluster have significantly lower weight for age z-scores than the urban high group. The average weight for age z-score for the urban high socio-economic group is found to be -0.74 in comparison to -1.36 in the urban low socio-economic group. However, the results in Table 7 show that even amongst the groups with the highest weight for age z-scores, the average value for the weight for age z-score remains below zero, highlighting the low nutritional status displayed by Indian children. This low nutritional status has been widely documented elsewhere (eg Gopalan 1992 and United Nations 1993). Therefore the groups which have significantly lower weight for age z-scores than the urban high socio-economic group are particularly disadvantaged in their nutritional status. They are significantly worse off than a group which already has low weight for age z-scores when compared to the National Centre for Health Statistics (NCHS) reference population[11]

In the next section the methodology and results used to model neonatal mortality using NFHS data are presented.

[11] For a discussion of the appropriateness of the NCHS reference population as a standard measure for assessing the nutritional status of Indian children see Gopalan (1992) or Griffiths (1998) for a summary of Gopalan's arguments.

Neonatal mortality

Neonatal mortality is modelled using logistic regression. The logistic modelling of neonatal mortality excludes children who had not been exposed to death for one month, to control for right censoring of the data caused by the cut-off point of the interview date in a cross-sectional survey such as the NFHS. Only children who were born between one month and five years prior to the survey date are included in the analysis. One reason for limiting the analysis to children born within five years of the survey date is that information on tetanus immunization, breastfeeding and health care is only collected for children who were born within this period. Another is the focus of this paper upon location and socio-economic status. By limiting the analysis to neonatal mortalities occurring in the past five years, the chance of a woman having moved from a rural to an urban environment or changing her socio-economic status is likely to be minimised. It is assumed that most women would not have changed the location in which they were residing or their socio-economic status in the five years leading up to the survey. The logistic regression equation used is the same as the one shown earlier for the use of antenatal care:

$$\ln(p/1\text{-}p) = a_0 + a_1 x_1 + a_2 x_2 + \ldots . a_k x_k$$

where

p = probability of neonatal death

a_0 a_1 , . . . a_k are regression coefficients

x_1 , x_2 … x_k are explanatory covariates

Table 8
Results of a logistic regression to predict neonatal mortality

Variable	Number	β	Standard Error β	Probability of Death
Constant	2579	-3.8370	0.6416	-
Premature birth				
On time	2495	Reference	-	0.0210
Early**	84	2.4234	0.3075	0.1949
Multiple birth				
Single	2549	Reference	-	0.0219
Multiple**	30	2.9494	0.4613	0.2996
Sex of child				
Male	1331	Reference	-	0.0298
Female**	1248	-0.5974	0.2341	0.0166
Antenatal care				
No/ missing	465	Reference	-	0.0521
Yes**	2114	-1.0593	0.2491	0.0187
Standard of living index				
Urban high	323	Reference	-	0.0075
Urban mediumns	329	0.7553	0.7246	0.0158
Urban low*	331	1.4693	0.6566	0.0316
Rural high*	479	1.2864	0.6472	0.0265
Rural medium*	469	1.3843	0.6411	0.0291
Rural low*	648	1.3529	0.6291	0.0283

Table 8 presents the results of the most parsimonious logistic regression model for neonatal mortality. The probabilities of dying are calculated by setting the covariates entered into the model at their mean values in the sample and entering the appropriate values for the variable of interest. In common with most other studies of neonatal mortality being born prematurely, being a multiple birth (eg Curtis and Steele 1996) and being male (eg Waldron 1985) were high risk factors for neonatal mortality. Other variables that were found to be significant in the analysis were the use of antenatal care and the Standard of Living Index (SLI). The association between antenatal care use and neonatal mortality strengthens the earlier suggestions that there is a need for good quality antenatal care services to be available to all women to increase the survival prospect of children. Khan (1987) and Beenstock and Sturdy (1990) have also found an association between use of maternal health care services and the survival prospects of the neonate in India.

Consistent with the findings for maternal health care and the nutritional status of infants shown previously, the location and SLI are found to be associated with neonatal mortality in Maharashtra. The urban medium and high groups show no significant difference in their probability of death in the neonatal period. However, all rural groups have a higher probability of experiencing neonatal mortality than the urban high cluster, although the group with the highest probability of dying in the first month of life is the urban low category. The probability of dying in the urban high group was predicted to be 0.008, compared to 0.028 for the rural low group, and 0.032 for the urban low group.

DISCUSSION

The results of this analysis suggest that the study of the utilisation of maternal health care services in India cannot be conceptualised merely in terms of a simple urban / rural dichotomy. For antenatal care and place of delivery it is clear that a 'living standard' gradient exists, such that differentials exist in the utilisation of MHC services both within and between rural and urban areas. Those in the urban and rural lower status groups consistently display lower rates of antenatal care utilisation, characterised by few visits timed late into pregnancy, and deliver less often in private institutions and more often at home. Previous literature has shown that the use of antenatal care has consequences for the survival prospects of neonates, and that the timing of antenatal care in the pregnancy is an important predictor of neonatal mortality (Stephenson 1998). Hence those in the lower socio-economic strata of both urban and rural areas are experiencing patterns of MHC utilisation associated with increased prospects of neonatal mortality. The use of a new index to measure standard of living has allowed the identification of socio-economic sub-groups with urban and rural areas, and has shown that these sub-groups are associated with differing levels of MHC utilisation, neonatal mortality and nutritional status.

The analysis presented in this paper has enabled the examination of the differences in the maternal health care utilisation between these very diverse sub-groups. Consistent differentials are observed within both urban and rural areas. However, although the urban low group always displays low rates of utilisation, the models do not show that this group has rates of MCH utilisation lower than the rural low SLI group. The urban low groups are not significantly different from the rural low groups in their timing and frequency of antenatal care and the places of delivery utilised. However, in the model to predict uptake of antenatal care (regardless of frequency, timing or place of delivery), the most disadvantaged group is the rural category with low standard of living. The other rural groups and all urban groups have near equal probabilities of using antenatal care. This suggests that although the urban low SLI group do not have a disadvantage when it comes to accessing antenatal care, the timing, frequency and delivery service accessed are all compromised by their low standard of living relative to the general urban population.

In Mumbai there is a strong preponderance of antenatal care use among slum dwellers, hence we may not expect to observe intra-urban differentials in antenatal care use. This tendency may be influenced by a policy that imposes a fine on women who arrive at a Government hospital for their delivery and have not previously attended antenatal care. As a result the first antenatal care visit in this context is often in the final trimester when the pregnancy is socially recognised, hence resulting in the poorest urban groups attending for

at least one antenatal care visit. It is not known if this policy is in operation in other Maharashtran urban areas.

Previous studies have shown that a clear urban / rural differential exists in the utilisation of MHC services in India, with much higher rates witnessed in urban populations (Archarya and Kanitkar 1994). However, the results presented here suggest that the patterns of MHC utilisation in India are more complex than this rural / urban differential implies.

In a related research project carried out by one of the authors of this paper, qualitative work was conducted in urban slums and rural areas of Pune and Mumbai using in-depth case study interviews (Griffiths and Stephenson 1999). This work found that the use of prenatal care was more prevalent in the urban areas studied. Socio-economic factors were consistently found to be associated with varying patterns of prenatal care use within urban and rural areas. In this qualitative work the absence of prenatal care within one of the poorest study villages, and the need to travel over half-an-hour by vehicle to the nearest government hospital to access such services, proved to be the main reason behind the non-use of prenatal care among the women interviewed. Hence, the findings presented here showing lower utilisation of antenatal care amongst the lowest SLI rural group could potentially be associated with a lack of operative health services in the nearby vicinity in the poorest rural areas. Griffiths and Stephenson (1999) also observed a financial hierarchy in the choice of institution used for delivery in urban areas, with private hospitals identified as the most costly place for childbirth. Those who wished to deliver in a formal institution yet could not afford the fees of a private hospital, reported using government services or private traditional health facilities that were less costly than private western medical care. Therefore women with similar beliefs about the need to deliver in an institution, gave birth in contrasting types of facility because of different access to economic resources which resulted in a variation in the ability to pay for the services offered. This can perhaps explain why women in the urban low group had a much higher probability of using government services for delivery than private services in the models, although it suggests that given the choice women in Maharashtra would choose private services. Hence, choice of service is constrained by financial limitations, which it may be suggested also operate within an urban context.

Results from the modelling of neonatal mortality show that antenatal care utilisation has a significant effect on subsequent early infant mortality. This effect is in addition to the striking influence of standard of living and urban/rural residence on mortality, which sets urban dwellers with high and medium living standards apart from other women. Thus the urban poor are at a disadvantage in terms of neonatal mortality compared with other urban dwellers. The probability of neonatal death for the urban low SLI group is approximately three time that fund in the high and medium SLU urban groups. This finding highlights the importance of SLI as a key correlate of neonatal mortality, as well as maternal heath care itself. Previous studies suggest that the continued rural/urban dichotomy in child survival prospects is a product of a combination of the differing childcare practices and reproductive behaviour in urban and rural areas of India, and the differential access to health services (Gandotra, Das and Dey 1982: Jain 1979). However, results presented here suggest that pockets of high neonatal mortality exist within urban areas and are associated with lower standards of living, again suggesting that the use of a simple rural/urban categorisation is not adequate.

The results for the modelling of nutritional status suggest that the utilisation of antenatal care services is not significantly related to the risk of low nutritional status. Thus the influence of maternal health care does not appear to influence nutritional status in the first year of life in the same way it influenced neonatal mortality. However, the nutritional status models measure the weight for age z-scores of children aged 1-11 months at the time of the survey and hence are not focussing upon the ages immediately after birth. These are the ages when antenatal care and place of delivery are likely to have their highest influences on morbidity and mortality as shown by the clear association presented in the neonatal mortality model. The nutrition model shows that the SLI categories display a similar association with low weight for age z-score to the previous association presented for neonatal mortality. The urban high and medium groups display the highest weight for age z-scores. Additionally, in predicting nutritional status the rural high SLI group was not found to be significantly different to the urban high and medium categories. However, the urban low and rural medium and low categories showed the highest probability of a low weight for age z-score. These infants from the low SLI groups in both rural and urban areas therefore have both a high risk of being classified as underweight and a higher probability of neonatal death than the high SLI groups. The difference is particularly high in urban areas where a wider disparity in the probabilities is observed.

Other socio-economic variables such as education and employment show significant associations within all of the MHC utilisation models, although these variables were not found to be significant for neonatal mortality or nutritional status. These results are consistent with previous studies which have shown that the utilisation of MHC services in India are highest among upper class Hindus, educated groups, and those involved in non-agricultural productivity (Saksena and Srivastava 1986). Thus the effects of standard of living observed are independent of the age and educational distribution of each group. In the opening section of the paper it was suggested that employment, education, knowledge of local community rules and age may all be associated with some aspects of a woman's status. These were the limited proxies for female status available in the NFHS data. The models presented here suggest that these proxies for female status are important in terms of MHC use. The findings of other studies (Bloom et al 1998) suggest that if more complete indicators of a woman's status had been available in the NFHS that an association with MHC would probably have been observed, given the association observed with the limited available proxies. The absence of these types of predictor for child outcomes is interesting, but the importance of such factors in the wellbeing of children cannot be ignored. In this paper associations with outcomes for the early infant period only have been considered. Previous work has identified variables such as education to take on a more important role beyond the early infant period in modelling both nutrition and mortality outcomes (Stephenson 1998, Griffiths 1998). In our analysis maternal education and employment were not significantly related to neonatal mortality, yet are linked to the utilisation of MHC services. Therefore, an indirect relationship may be present in which a woman's social characteristics act to influence neonatal mortality through the use of MHC services.

Previous studies have found associations between composite indices of socio-economic status and the utilisation of maternal health care services (Obermeyer and Potter 1991: Obermeyer 1993). In addition, a clear differential between urban and rural areas of India in the use of maternal health services has been demonstrated (Karnatikar and Sinha 1986). However, the use of a standard of living *in combination* with urban/rural residence puts both MHC use and early child wellbeing into a new context. In a setting such as

Maharashtra, where a wide diversity of lifestyles exist in a rapidly modernising context, the comparison of urban and rural is too simplistic. The standard of living index presented here has allowed the comparison of the relative status of people within urban and rural areas, and has proved significant in the modelling of maternal and child health outcomes. The index could be applied to other similar demographic and health survey data to measure these associations in other settings. The contrast in the health and mortality experiences of urban and rural populations needs elaborating to include the standard of living to allow the representation of the very different backgrounds in which women live, care for their children and experience pregnancy and childbirth. These factors are important in the understanding of both MHC service use and early infant mortality and nutritional outcomes.

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Appendix A - Variables used for the creation of the standard of living index

Variable	Urban		Rural	
	Frequency (%)	Score	Frequency (%)	Score
Separate room used as kitchen				
Yes	49.0	2	60.4	2
No	51.0	0	39.6	1
Type of housing materials used to construct house				
Pucca	51.6	3	8.7	5
Kachha	18.6	0	62.7	2
Semi-Pucca	29.8	2	28.6	3
Main source of lighting				
Electricity	83.9	2	64.8	2
Kerosene	15.8	1	35.0	1
Other	0.3	0	0.2	0
Type of fuel used for cooking				
Wood	20.9	1	87.5	2
cow dung cakes	0.2	0	3.4	1
coal	2.5	1	0.3	3
charcoal	0.4	1	0.0	1
kerosene	46.2	2	3.9	4
electricity	0.3	4	0.1	5
liquid petroleum	28.6	3	3.5	4
bio-gas	0.9	4	1.3	4
Type of toilet facility				
own flush toilet	29.3	2	5.0	5
shared flush toilet	13.8	1	0.2	4
public flush toilet	24.3	1	1.6	4
own pit/latrine	2.3	1	1.9	3
shared pit/latrine	2.4	1	0.3	3
public pit/toilet/latrine	4.8	0	0.2	3
no facility/bush	23.1	0	90.8	2
Source of drinking water				
piped water	56.9	2	21.3	5
public tap	32.2	1	28.3	4
handpump	3.3	1	15.0	4
well	6.6	0	31.5	2
other	1.0	0	3.9	0
Owns livestock				
Yes	11.2	1	63.1	2
No	88.8	2	36.9	1
Owns agricultural land				
Yes	30.8	1	71.6	2
No	69.2	2	28.4	1
Owns a sewing machine				
Yes	26.6	3	10.6	4
No	73.4	2	89.4	2
Owns a clock/watch				
Yes	71.7	2	45.5	1
No	28.3	1	54.5	2
Owns a sofa set				
Yes	18.1	4	3.6	5
No	81.9	2	96.4	2

Appendix A Continued - Variables used for the creation of the standard of living index

Owns a fan Yes No	63.3 36.7	2 0	20.4 79.6	4 2
Owns a radio Yes No	50.3 49.7	2 1	34.9 65.1	4 2
Owns a refrigerator Yes No	15.2 84.8	4 2	1.1 98.9	5 2
Owns a television Yes No	46.6 53.4	3 2	13.5 86.5	4 2
Owns a VCR Yes No	5.4 94.6	5 2	1.6 98.4	5 2
Owns a bicycle Yes No	32.5 67.5	3 2	36.1 63.9	4 2
Owns a motorcycle/scooter Yes No	12.9 87.1	3 2	6.9 93.1	4 2
Owns a car Yes No	2.4 97.6	5 2	0.6 99.4	5 2
Owns a tractor Yes No	0.4 99.6	3 2	0.7 99.3	5 2
Owns a thresher Yes No	0.6 99.4	3 2	1.1 98.9	5 2
Owns a bullock cart Yes No	1.6 98.4	0 2	20.3 79.7	4 2
Owns a water pump Yes No	0.7 99.3	5 2	2.4 97.6	5 2
Total	100		100	
Max		68		93
Min		26		38

Appendix B - Variables used in antenatal care model

1. Place of residence combined with standard of living
2. Respondent's education
3. Caste
4. Religion
5. Availability of health services in the village
6. Ever Heard of ORS product
7. Sex preference of next child
8. Partner ever attended school
9. Respondent's age
10. Family/household type (extended/ nuclear etc)
11. Respondent's Knowledge of the minimum legal age of marriage for females
12. Mother-in-law in household
13. Crowded living conditions
14. Number of years lived in the area by the respondent
15. Desire of the respondent to get pregnant at that time, later or not at all

APPENDIX C - Variables Used in Timing of First Antenatal Care Visit Model and The Number of Antenatal Care Visits Made

1. Place of residence by standard of living index
2. Listens to a radio once a week
3. Watches television once a week
4. Respondents' education
5. Caste
6. Religion
7. Respondents' age
8. Family/household type
9. Mother-in-law in household
10. Partner ever attended school
11. Respondent currently working
12. Number of children ever born
13. Childhood place of residence
14. Whether the respondent ever had an abortion
15. Desire of the respondent to get pregnant at that time, later or not at all.

Variables Used in Place of Delivery Model

1. Place of residence by standard of living index
2. Listens to a radio once a week
3. Watches television once a week
4. Respondents' education
5. Caste
6. Religion
7. Respondents' age
8. Family/household type
9. Mother-in-law in household
10. Partner ever attended school
11. Respondent currently working
12. Number of children ever born
13. Childhood place of residence
14. Whether the respondent ever had an abortion
15. Desire of the respondent to get pregnant at that time, later or not at all
16. The number of months pregnant respondent was when any health worker visited her for antenatal check-up
17. The number of times the health worker visited the respondent for antenatal check-up during her pregnancy
18. If the respondent went for an antenatal check-up
19. Who the respondent saw for her antenatal check-up
20. Timing of the first antenatal check-up
21. The number of times the respondent saw someone for antenatal care during her pregnancy
22. Main reason for not going for antenatal check-up.
23. Whether the woman was given iron and folic acid tablets during this pregnancy
24. Whether the respondent received a tetanus injection during this pregnancy

Parameter Estimates For A Multinomial Logistic Model To Predict The Timing Of The First Antenatal Care Visit

Variable (n)	0-3 Months		4-6 Months	
	Estimate[12]	***Standard*** Error	Estimate	***Standard*** Error
Constant	-0.607	0.198	0.058	0.184
Standard of Living by Residence				
Urban Low (276)	-0.676**	0.219	-0.886**	0.212
Urban Middle (294)	-0.930**	0.204	-1.355**	0.215
Urban High (317)	-0.109	0.211	-0.730**	0.234
Rural Low (279)	-0.114	0.235	0.231	0.0.209
Rural Middle (270)	0.341	0.233	0.574**	0.216
Rural High (361)	Reference	Reference	Reference	Reference
Education				
Illiterate (709)	Reference	Reference	Reference	Reference
Primary (532)	0.515**	0.159	0.012	0.149
Middle (231)	1.046**	0.214	0.443*	0.217
High + (325)	1.811**	0.218	0.389	0.239
Religion				
Hindu (1257)	Reference	Reference	Reference	Reference
Muslim (343)	-0.529**	0.163	-0.424**	0.163
Other (197)	-0.232	0.197	-0.290	0.203
Employment				
Women who are not employed (1156)	0.495 **	0.148	0.333*	0.142
Women who are employed (641)	Reference	Reference	Reference	Reference

In the table, the parameter estimates are calculated by comparing the timing of the first antenatal care visit with the last trimester

Parameter Estimates For A Multinomial Logistic Model To Predict The Number Of Antenatal Care Visits Made

Variable (n)	4 visits		5+ Visits	
	Estimate[13]	***Standard*** Error	Estimate	***Standard*** Error
Constant	-2.088	0.272	-0.994	0.200
Standard of Living by Residence				
Urban Low (276)	0.592*	0.261	0.174	0.199
Urban Middle (294)	0.936**	0.286	0.604**	0.182
Urban High (317)	1.012**	0.288	1.126**	0.190
Rural Low (279)	0.029	0.302	-0.382	0.217
Rural Middle (270)	-0.178	0.195	-0.193	0.203
Rural High (361)	Reference	Reference	Reference	Reference
Education				
Illiterate (709)	Reference	Reference	Reference	Reference
Primary (532)	-0.897	0.195	0.327*	0.148
Middle (231)	-0.125	0.284	0.704**	0.190
High + (325)	0.507	0.285	1.340**	0.202
Number of Children				
1 (609)	Reference	Reference	Reference	Reference
2-3 (853)	-0.241	0.192	-0.551**	0.138
4+ (335)	-0.944**	0.285	-1.225**	0.209
Age of Mother				
<19 years (230)	0.648**	0.244	-0.072	0.196
20-24 years (764)	Reference	Reference	Reference	Reference
25-29 years (535)	0.690**	0.204	0.662**	0.146
30+ years (268)	1.082**	0.259	0.912**	0.198

In the table, the parameter estimates are calculated by comparing the timing of the first antenatal care visit with the last trimester

Parameter estimates for a multinomial logistic model to predict place of delivery for first births

Variable (n)	Parents, Other Home		Government Hospital		Private Hospital	
	Estimate[14]	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Constant	-0.242	0.659	0.188	0.675	0.221	0.749
Standard of living and Residence						
Urban Low (86)	Reference	Reference	Reference	Reference	Reference	Reference
Urban Medium and High (243)	0.275	0.528	0.242	0.486	1.415**	0.552
Rural Low (165)	-0.091	0.433	-1.309**	0.466	-0.098	0.574
Rural Medium and High (280)	0.367	0.432	-0.423	0.426	0.479	0.512
Education of Mother						
Illiterate (297)	0.484	0.385	-0.549	0.368	-1.573**	0.409
Literate-primary (218)	0.342	0.392	-0.409	0.362	-0.565	0.362
Middle-High School (259)	Reference	Reference	Reference	Reference	Reference	Reference
Religion						
Hindu (578)	Reference	Reference	Reference	Reference	Reference	Reference
Muslim (103)	-0.033	0.380	-0.192	0.391	-1.356**	0.438
Other (93)	-0.214	0.372	0.271	0.388	-0.567	0.442
Childhood place of residence						
Village (497)	-0.080	0.363	-0.968**	0.336	-1.614**	0.347
City/Town (277)	Reference	Reference	Reference	Reference	Reference	Reference
Employment						
Women who are not employed (497)	Reference	Reference	Reference	Reference	Reference	Reference
Women who are employed (277)	0.404	0.244	0.803**	0.273	1.292**	0.308
Home Visit by Health Worker						
Yes (152)	-0.787**	0.261	-0.628*	0.319	-1.040**	0.357
No (622)	Reference	Reference	Reference	Reference	Reference	Reference

[14] In Table The parameter estimates are calculated by comparing the place of delivery listed at the top of the column with respondents home for delivery

Parameter estimates for a multinomial logistic model to predict place of delivery for first births (continued)

Antenatal Care						
1-2 visits (137)	0.134	0.308	1.465**	0.417	0.966*	0.460
3-4 visits (213)	0.221	0.306	1.663**	0.402	0.790	0.440
5+ visits (260)	-0.167	0.353	1.534**	0.425	1.500**	0.443
No antenatal care (164)	Reference	Reference	Reference	Reference	Reference	Reference

Parameter estimates and estimated probabilities for a multinomial logistic model to predict place of delivery for subsequent births

Variable (n)	Parents, Other Home		Government Hospital		Private Hospital	
	Estimate[15]	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Constant	-0.325	0.352	-1.705	0.399	-2.621	0.501
Standard of living and Residence						
Urban Low (252)	-1.615**	0.383	-0.426	0.245	-1.443**	0.292
Urban Medium and High (417)	Reference	Reference	Reference	Reference	Reference	Reference
Rural Low (477)	-0.573*	0.280	-2.186**	0.282	-2.438**	0.334
Rural Medium and High (673)	-0.321	0.263	-1.710**	0.227	-2.188**	0.247
Education of Mother						
Illiterate (1002)	Reference	Reference	Reference	Reference	Reference	Reference
Literate-primary (482)	-0.253	0.172	0.440**	0.174	0.746**	0.218
Middle-High School (335)	-0.242	0.261	0.553*	0.241	1.492**	0.263
Religion						
Hindu (1299)	Reference	Reference	Reference	Reference	Reference	Reference
Muslim (357)	-0.632**	0.214	-0.442*	0.199	-0.158	0.228
Other (163)	0.262	0.258	0.728**	0.260	0.055	0.327
Caste						
Scheduled Caste and Scheduled Tribe (343)	Reference	Reference	Reference	Reference	Reference	Reference
Other caste groups (1476)	0.450**	0.168	0.351	0.212	0.585*	0.289
Employment						
Women who are not employed (955)	Reference	Reference	Reference	Reference	Reference	Reference
Women who are employed (864)	-0.029	0.153	0.282	0.167	0.451*	0.208

[15] In Table The parameter estimates are calculated by comparing the place of delivery listed at the top of the column with respondents home for delivery

Parameter estimates and estimated probabilities for a multinomial logistic model to predict place of delivery for subsequent births (continued)

Age of mother and number of children						
< 19 years and 2 children (65)	0.096	0.356	0.237	0.485	1.103*	0.519
20-24 years and 2 children (224)	Reference	Reference	Reference	Reference	Reference	Reference
25-29 years and 2 children (122)	-0.160	0.392	0.697	0.392	1.028**	0.410
30+ years and 2 children (421)	-0.046	0.640	0.389	0.678	1.351*	0.667
< 19 years and 3+ children (42)	-0.307	0.433	0.347	0.534	0.535	0.663
20-24 years and 3+ children (480)	-0.241	0.220	0.164	0.262	0.152	0.312
25-29 years and 3+ children (504)	-0.491*	0.223	0.084	0.254	-0.116	0.299
30+ years and 3+ children (340)	-0.916**	0.260	0.066	0.278	0.555	0.314
Antenatal Care						
1-2 visits (352)	0.426*	0.174	1.714	0.239**	1.200**	0.341
3-4 visits (477)	0.235	0.180	1.932	0.230**	1.930**	0.302
5+ visits (364)	0.565*	0.257	2.656	0.270**	3.159**	0.328
No antenatal care (626)	Reference	Reference	Reference	Reference	Reference	Reference

Appendix D - Variables used in nutritional status model

1. Standard of living index
2. Mother-in-law resides in the household?
3. Family Type (Nuclear, extended etc)
4. Literacy of husband
5. Crowding in the household
6. Cowdung used in cooking?
7. Religion
8. How many years resident in the place?
9. Knowledge of minimum legal age of marriage
10. Education of mother
11. Number of sons & daughters at home
12. Mother knows of oral rehydration salts?
13. Scheduled caste or tribe?
14. Age of mother at child's birth
15. Sex of child
16. Age of child
17. Mother received antenatal care?
18. Mother received iron/folic acid tablets?
19. Was baby premature?
20. Size of baby at birth
21. Did baby feed in the first hour?
22. Was milk squeezed from the breast?
23. Has child ever had whooping cough?
24. Has child had fever in past two weeks?
25. Has child had cough in past two weeks?
26. Has child had diarrhoea in past two wks?
27. Length of preceding birth interval?
28. Total children ever born to mother
29. Death of any siblings?
30. Survival of the previous birth

Appendix E - Variables used in mortality models

1. Antenatal care/number of visits
2. Health services in the village
3. ORS knowledge
4. Received iron/folic acid tablets
5. Mother received tetanus job
6. Place of delivery
7. Complications in delivery
8. Birth order
9. Previous child died
10. Number of births in past 2 yrs
11. Mother's age at birth
12. Preceding birth interval
13. Premature birth
14. Single or multiple birth
15. Sex of child
16. Size of child at birth
17. Child fed immediately after birth
18. Squeeze milk from breast
19. Caste
20. Religion
21. Cow dung used for cooking
22. Crowded living conditions
23. Respondent's knowledge of the legal age at marriage for females
24. Maternal education
25. Partner ever attended school
26. Familial type
27. Mother-in-law in household
28. Usual resident in household
29. Time lived in place years
30. Related to husband at marriage